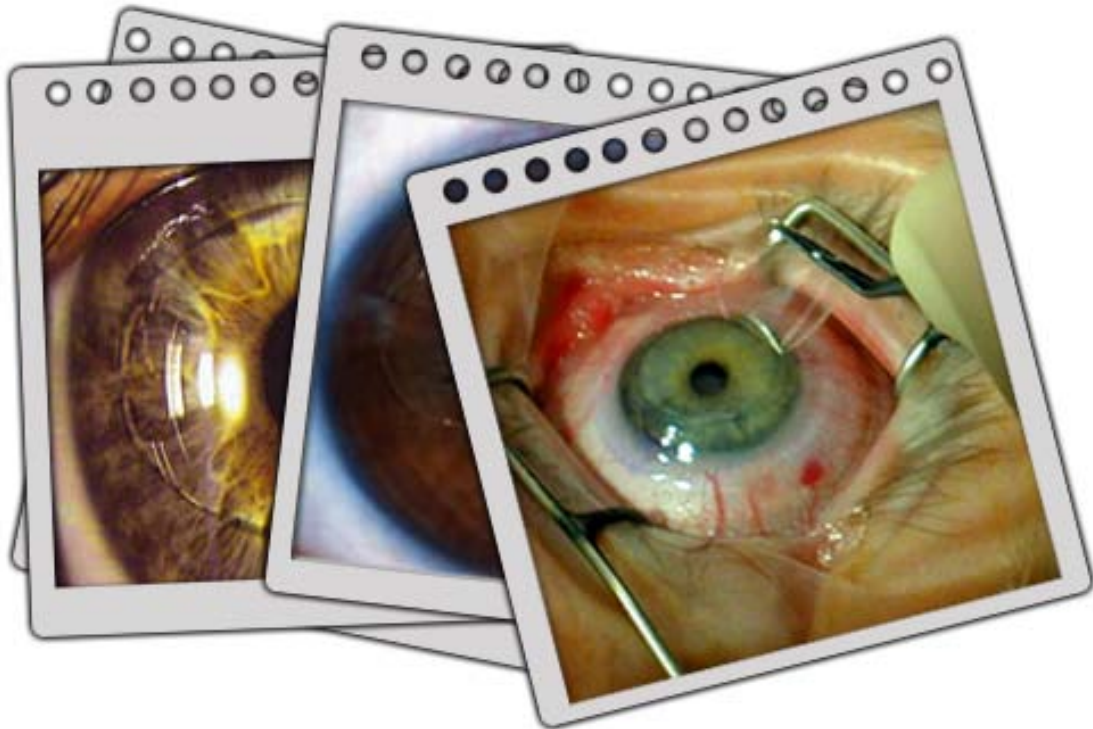
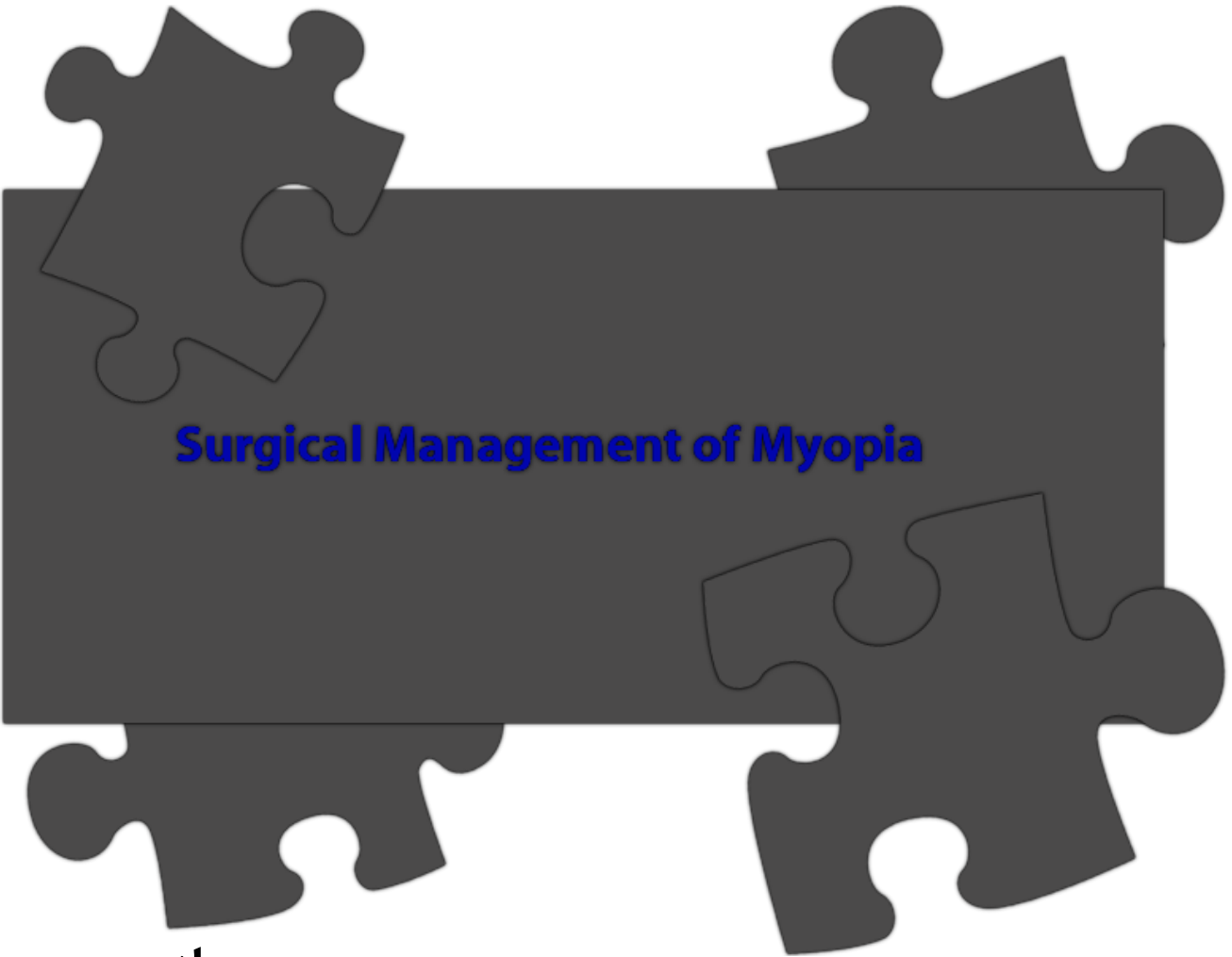


AINSHAMS UNIVERISTY
DEPARTMENT OF OPHTHALMOLOGY



SURGICAL MANAGEMENT OF MYOPIA



Surgical Management of Myopia

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Aim of the Spotlight

To throw a spotlight on the general concepts of myopia, its types, symptoms and signs, management. The spotlight is mainly directed to give a brief view on the surgical management of the myopia.

Introduction

Refraction is the phenomenon which makes image formation possible by the eye as well as by cameras and other systems of lenses.

Most of that refraction in the eye takes place at the first surface, since the transition from the air into the cornea is the largest change in index of refraction which the light experiences. About 80% of the refraction occurs in the cornea and about 20% in the inner crystalline lens.

While the inner lens is the smaller portion of the refraction, it is the total source of the ability to accommodate the focus of the eye for the viewing of close objects. For the normal eye, the inner lens can change the total focal length of the eye by 7-8%.

Spotlight Review

Definition of the Myopia

Myopia, also called near- or short-sightedness, is a refractive defect of the eye in which light produces image focus in front of the retina when accommodation is relaxed.

Those with myopia see nearby objects clearly but distant objects appear blurred. With myopia, the eyeball is too long, or the cornea is too steep, so images are focused in the vitreous inside the eye rather than on the retina at the back of the eye.

Classification of the Myopia

According to the Etiology:

1-Axial Myopia:

It is due to an increase in the eye's axial length. It is the most common cause of myopia

2-Refractive Myopia:

It is attributed to the condition of the refractive elements of the eye.

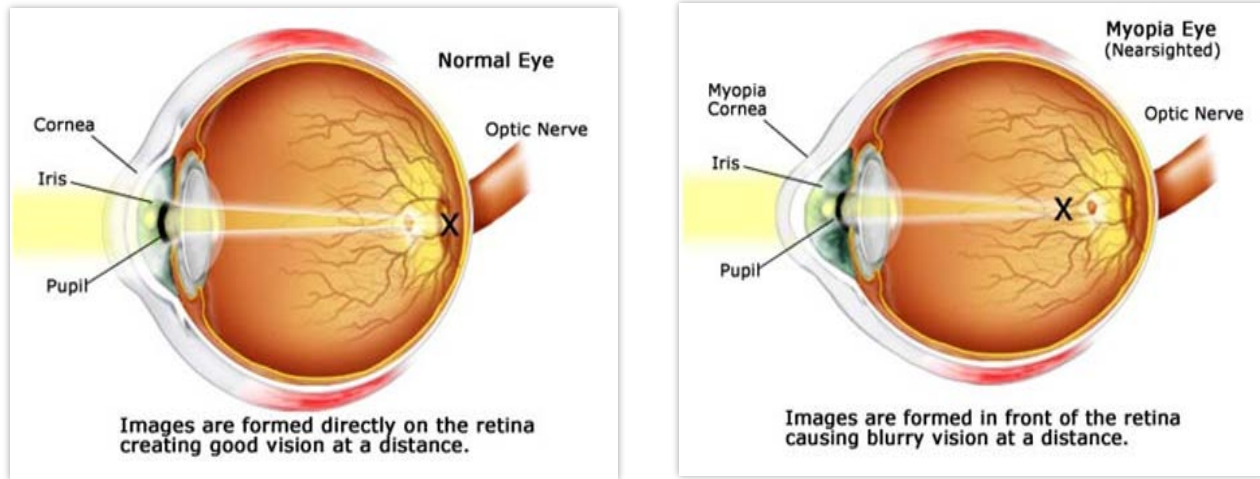
Borish further sub classified refractive myopia into:

A-Curvature Myopia:

It is attributed to excessive, or increased, curvature of one or more of the refractive surfaces of the eye, especially the cornea. In those with Cohen syndrome, myopia appears to result from high corneal and lenticular power.

B-Index Myopia:

It is attributed to variation in the index of refraction of one or more of the ocular media.



According to Clinical Aspects:

A-Simple Myopia:

It is more common than other types of myopia and is characterized by an eye that is too long for its optical power (which is determined by the cornea and crystalline lens) or optically too powerful for its axial length. Both genetic and environmental factors, particularly significant amounts of near work, are thought to contribute to the development of simple myopia.

B-Degenerative Myopia:

It also known as malignant, pathological, or progressive myopia, is characterized by marked fundus changes, such as posterior staphyloma, and associated with a high refractive error and subnormal visual acuity after correction. This form of myopia gets progressively worse over time. Degenerative myopia has been reported as one of the main causes of visual impairment.

C-Nocturnal Myopia:

It also known as night myopia myopia is a condition in which the eye has a greater difficulty seeing in low illumination areas, even though its daytime vision is normal. Essentially, the eye's far point of an individual's focus varies with the level of light. Night myopia is believed to be caused by pupils dilating to let more light in, which adds aberrations resulting in becoming more nearsighted. A stronger prescription for myopic night drivers is often needed. Younger people are more likely to be affected by night myopia than the elderly.

D-Pseudo Myopia:

It is the blurring of distance vision brought about by spasm of the ciliary muscle.

E-Induced Myopia:

also known as acquired myopia, results from exposure to various pharmaceuticals, increases in glucose levels, nuclear sclerosis, or other anomalous conditions. The encircling bands used in the repair of retinal detachments may induce myopia by increasing the axial length of the eye.

Symptoms and Sign of Myopia

Symptoms:

- Indistinct far vision
- Discomfort or eye strain after near work due to disproportion between accommodation and convergence.
- Divergent squint.
- Musca volitantes may occur due to vitreous floaters.
- Symptoms of degenerative changes in degenerative myopia.
e.g.: defective central vision

Signs:

I- External appearance:

In small degrees of myopia the eye looks normal.

In high degrees of axial myopia the eye is big so the cornea is relatively large. The anterior chamber is deep and the pupil may be large.

In very high degrees of axial myopia the globe appears as if proptotic (pseudo-proptosis).

II- Internal appearance:

– Simple Myopia: the fundus may look normal or shows what is known as tigeroid fundus.

– Degenerative Myopia :

- 1- Temporal crescent: due to marked stretching of the sclera.
- 2- Posterior staphyloma: due to protrusion of the weak degenerated sclera under the effect of IOP.
- 3- Choroidal sclerosis.
- 4- Sub retinal neovascularization.
- 5- Peripheral chorio-retinal degeneration.
- 6- Vitreous degeneration.

Other complications related to degenerative myopia

- Posterior cortical cataract.
- Chronic simple glaucoma.
- Squint.
 - Apparent convergent squint.
 - True divergent squint.
- Rhegmatogenous retinal detachment.

Management of Myopia

Non Surgical Management:

- ✓ Glasses: Diverging, minus lens
- ✓ Contact Lenses: Used in high degrees of myopia

Surgical Management:

Surgical correction can be applied to eye with stable myopia, usually not before the age of 20

Surgical correction includes:

- *Laser surgeries:*
 - ✓ Photorefractive Keratectomy (PRK).
 - ✓ Laser Epithelial Keratomileusis (LASEK).
 - ✓ Laser in-situ Keratomileusis (LASIK).
- *Lens implanting surgeries:*
 - ✓ Clear Lens Extraction and Intraocular lens Implantation.
 - ✓ Phakic Intraocular Lens.
- *Others*
 - ✓ Micro-thin Prescription Inserts
 - ✓ Multiple Procedures
 - ✓ Radial keratotomy
 - ✓ IntraLase Surgery

Surgical Management of Myopia

Laser Refractive Surgeries:

- ✓ Photorefractive Keratectomy (PRK).

Photorefractive keratectomy (PRK) consists of the application of energy of the ultraviolet range generated by an Argon Fluoride (ArF) Excimer laser to the anterior corneal stroma to change its curvature and, thus, to correct a refractive error.

Indication

Clinical indications for PRK include the following:

- ☐ Myopia (-1.0 D to -6.0 D).
- ☐ Astigmatism (0.75 D to 3.0 D).
- ☐ Hyperopia (+1.0 D to +4.0 D) .
- ☐ PRK in corneas previously treated with LASIK
- ☐ Treatment of Anisometropic Amblyopia in children.

Preoperative details

- Preoperative evaluation before PRK includes the following:
- Refractive history (including history of contact lens wear)
- Uncorrected and best-corrected visual acuity
- Manifest and cycloplegic refraction
- Videokeratography and Keratometry
- Slit lamp examination
- Tonometry
- Dilated funduscopy

Assessment of a patient's ability to tolerate the procedure under topical anesthesia, to fixate steadily, to lie flat without difficulty, to understand the nature of the procedure and to give an informed consent.

Intraoperative details

After placement of antibiotic and anesthetic drops in the eye, the eyelid is held open using a speculum.

When using the mechanical epithelial removal technique, a 6.0- or 6.5-mm marker can be used, centered over the entrance pupil to mark the area where the epithelium is to be removed. The epithelium can be removed using a blunt spatula or a small blade, such as a Beaver 64.

After epithelial removal, the surface of the cornea must be wiped with a non fragmenting sponge that has been soaked with balanced sterile saline and then squeezed so it is moist but not saturated. During the procedure, focusing properly on the stromal surface and avoiding excessive illumination to allow patient fixation are important. A Thornton ring or similar instrument can be used to gently help the patient maintain fixation without distorting the corneal surface.

The Excimer laser beam is centered on the entrance pupil and focused on the anterior stromal surface, and the laser treatment is applied.

Postoperative details

Placing a therapeutic contact lens for an average of 3 days is helpful, as well as using a combination of antibiotic / steroid drops. Alternatively, a pressure patch following application of an antibiotic/steroid ointment is well tolerated. Analgesic and anti anxiety oral medications should be used during the first 24 hours postoperatively.

Follow-up

Patients should be monitored daily after PRK until the re-epithelialization is complete. At this time, the therapeutic contact lens can be removed, and the patient can be monitored 1 week later. The remaining follow up interval times can double until the vision stabilizes.

Contraindications

Contraindications include the following:

Collagen, vascular, autoimmune, or immunodeficiency diseases; pregnancy or breastfeeding; keratoconus; medications, such as Accutane (isotretinoin) or Cordarone (amiodarone hydrochloride); and a history of keloid formation.

Medical therapy

Following PRK, topical antibiotics should be used with a therapeutic contact lens until re-epithelialization is complete. Furthermore, a weak corticosteroid, such as fluorometholone 0.1%, frequently is used to avoid excessive collagen deposition.

Topical intraoperative application of 0.02% Mitomycin C can reduce haze formation in highly myopic eyes undergoing PRK.

Complications

Complications following PRK include the following:

- **LASER related errors & doctor errors**

- Decentration of the ablation zone: This may occur following inadequate centration on the entrance pupil at the time of laser application. The treatment may include a retreatment guided by corneal topography and/or 3D corneal topography (elevation map).
- Central islands: Excimer lasers with a flat-top energy beam profile have the potential of producing central islands. Four main theories exist as to the cause of central islands, as follows: focal central epithelial hyperplasia, the vortex plume theory, degradation of laser optics, and the acoustic shock wave theory. However, central island formation is most likely multifactorial.
- Modern excimer lasers have built-in software to neutralize the possible appearance of central islands. This software acts by centrally applying additional pulses.
- Undercorrections, overcorrections, and induced astigmatism: As the most common complications that occur following PRK, they may be caused by inadequate centration or focusing at the time of surgery. Management of these complications often includes a retreatment using either a second PRK procedure or LASIK after the initial result has stabilized
- Corneal melting and perforation: This has been reported in patients with connective tissue disease.
- A penetrating keratoplasty may be necessary in these cases to restore vision and ocular integrity.

- **Steroids complications**

- Increase in intraocular pressure (IOP) associated with the use of postoperative steroids: In all cases, IOP reverts to normal values on discontinuation of topical steroids. No reports of persistent increased IOP exist in the literature.
- Steroid-induced herpes simplex keratitis: This complication may be associated with the use of postoperative steroids or possibly from the stress of the excimer laser. In patients with a known history of herpes simplex viral keratitis, the use of preoperative and postoperative topical/oral acyclovir or trifluorothymidine drops is warranted.
- Posterior subcapsular cataracts: These have been reported infrequently in patients who used dexamethasone phosphate postoperatively.

- Complications related to the use of therapeutic **contact lenses**, including infectious keratitis: Treatment of this complication requires corneal scrapings for culture and sensitivity, as well as the use of fortified topical antibiotics.
- Sterile paracentral corneal infiltrates: These infiltrates can be treated with fortified topical antibiotics and topical steroids, respectively
- Delayed epithelial healing.
- Recurrent corneal erosions: This complication may occur in the presence of basement dystrophy unrecognized during the preoperative evaluation. The treatment may include PTK and the use of hypertonic saline solution.
- Regression: This complication may occur postoperatively, particularly in young patients or those with high corrections for up to 6 months following PRK. Initial treatment with topical steroids may halt regression. If a regression results in visually significant changes, a PRK or LASIK retreatment can be performed once refractive stabilization has been documented.
- NSAID related complication
 - Reticular stromal haze: Why some patients develop this pattern on the anterior stroma is unclear. It has been associated with the use of postoperative nonsteroidal anti-inflammatory drugs (NSAIDs). In many cases, it does not affect a patient's visual acuity. Initial management of corneal haze usually consists of waiting until the opacity fades spontaneously. Treatment of persistent moderate-to-severe haze includes the use of topical steroids and/or a second laser application (eg, PRK, phototherapeutic keratectomy [PTK]). Only haze that is causing a reduction in visual acuity should be considered for retreatment. An association exists between significant regression and the formation of severe reticular haze.
 - Superficial keratopathy: This has been reported in association with topical NSAIDs or the preservatives used in other drops.

Prognosis and outcome

- In myopic PRK, refractive stability achieved at 1 year was maintained up to 12 years with no evidence of hyperopic shift, diurnal fluctuation, or late regression in the long term. Corneal haze decreased with time, with complete recovery of BSCVA. Night halos remained a significant problem in a subset of patients due to the small ablation zone size.

✓ Laser in-situ Keratomileusis (LASIK)

A **LASIK** procedure is to use a Microkeratome to cut a thin flap of cornea and then apply the Excimer laser to remove tissue from within the cornea.

Technique

The first part involves the use of an instrument, the Microkeratome, to create a thin protective layer of corneal tissue that covers the area to be sculpted by the laser. This flap allows for rapid recovery of vision, reduces discomfort after surgery and prevents scarring. The second part uses a computer controlled Excimer laser to sculpt the underlying cornea, correcting the refractive error. It restores a more natural shape to the surface of your cornea, thereby correcting your vision.

The LASIK Procedure

There are several necessary preparations in the preoperative period. The operation itself is made by creating a thin flap on the eye, folding it to enable remodeling of the tissue underneath with laser. The flap is repositioned and the eye is left to heal in the postoperative period.

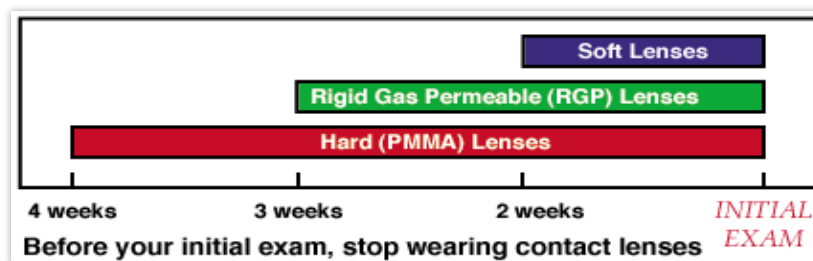
Preoperative:

Patients wearing soft **contact lenses** are usually instructed to stop wearing them approximately 5 to 21 days before surgery.

Patients wearing hard contact lenses should stop wearing them for a minimum of 6 weeks plus another 6 weeks for every 3 years the hard contacts have been worn.

The patient typically is prescribed an antibiotic to start taking beforehand, to minimize the risk of infection after the procedure.

Before the surgery, the patient's **corneas** are examined with a **Pachymeter** to determine their thickness, and with a topographer to measure their surface contour. **Using low-power lasers, a topographer creates a topographic map of the cornea. This process also detects astigmatism and other irregularities in the shape of the cornea.** Using this information, the surgeon calculates the amount and locations of corneal tissue to be removed during the operation.

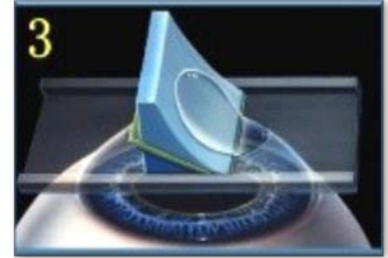
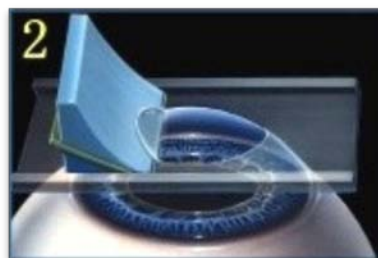
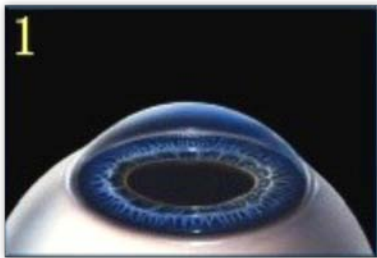


LASIK Procedure:

The operation is performed with the patient awake and mobile; however, the patient is sometimes given a mild **sedative** (such as **Valium**) and anesthetic **eye drops**. LASIK is performed in 3 stages:

➤ Flap creation

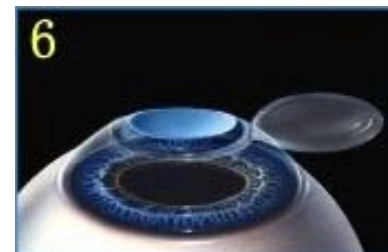
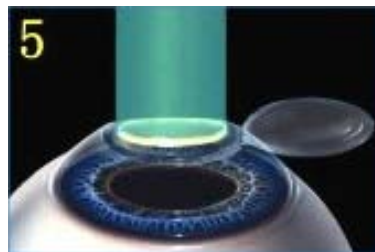
A corneal suction ring is applied to the eye, holding the eye in place. This step in the procedure can sometimes cause small blood vessels to burst, resulting in bleeding or **sub conjunctival hemorrhage** into the white (**sclera**) of the eye, a harmless side effect that resolves within several weeks. Increased suction typically causes a transient dimming of vision in the treated eye. Once the eye is immobilized, the flap is created. This process is achieved with a mechanical **Microkeratome** using a metal blade, a hinge is left at one end of this flap. The flap is folded back, revealing the **stroma**.



➤ Laser remodeling

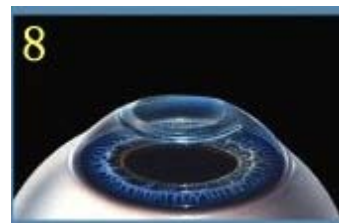
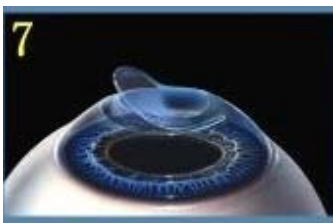
The second step of the procedure is to use an **Excimer laser** (193 nm) to remodel the corneal stroma. The laser **vaporizes** tissue in a finely controlled manner without damaging adjacent stroma. No burning with heat or actual cutting is required to ablate the tissue. The layers of tissue removed are tens of **micrometers** thick. Performing the laser ablation in the deeper corneal stroma typically provides for more rapid visual recovery and less pain, than the earlier technique **photorefractive keratectomy** (PRK).

During the second step, the patient's vision will become very blurry once the flap is lifted. He/she will be able to see only white light surrounding the orange light of the laser. This can be disorienting.



➤ Reposition of flap

After the laser has reshaped the stromal layer, the LASIK flap is carefully repositioned over the treatment area by the surgeon and checked for the presence of air bubbles, debris, and proper fit on the eye. The flap remains in position by natural adhesion until healing is completed.



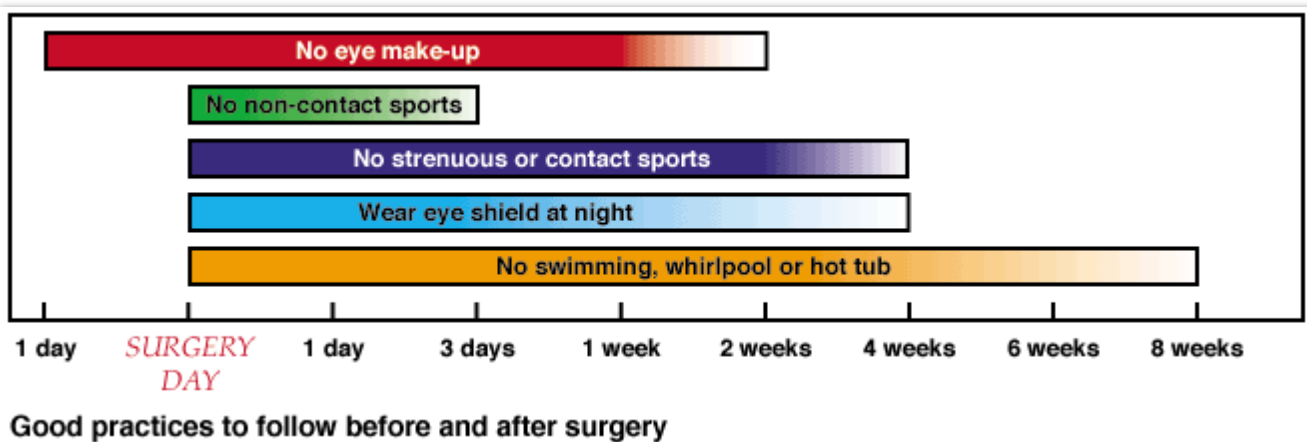
Postoperative:

Patients are usually given a course of antibiotic and anti-inflammatory eye drops. These are continued in the weeks following surgery.

Patients are usually told to sleep much more and are also given a darkened pair of shields to protect their eyes from bright lights and protective goggles to prevent rubbing of the eyes when asleep and to reduce dry eyes.

They also have to moisturize the eyes with preservative free tears and follow directions for prescription drops.

Patients should be adequately informed by their surgeons of the importance of proper post-operative care to minimize the risk of postsurgical complications.

**Wavefront-guided LASIK**

Wavefront-guided LASIK is a variation of LASIK surgery where, rather than applying a simple correction of focusing power to the cornea (as in traditional LASIK), an [ophthalmologist](#) applies a spatially varying correction, guiding the computer controlled Excimer laser with measurements from a wavefront sensor. The goal is to achieve a more optically perfect eye, though the final result still depends on the physician's success at predicting changes which occur during healing. In older patients though, [scattering](#) from microscopic particles plays a major role and may exceed any benefit from wavefront correction. Hence, patients expecting so-called "super vision" from such procedures may be disappointed. However, while unproven, surgeons claim patients are generally more satisfied with this technique than with previous methods, particularly regarding lowered incidence of "halos", the visual artifact caused by [spherical aberration](#) induced in the eye by earlier methods.

Complications:**Intra operative complications:**

- Flap complications:

Such as displaced flaps or folds in the flaps that necessitate repositioning, diffuse lamellar keratitis, and epithelial ingrowth are common in lamellar corneal surgeries but rarely lead to permanent visual acuity loss

- Slipped flap (a corneal flap that detaches from the rest of the cornea) is one of the most common complications. The chances of this are greatest immediately after surgery.

Early postoperative complications:

- Diffuse lamellar keratitis (DLK), also known as the Sands of Sahara syndrome, has been estimated at 2.3%
- Infection responsive to treatment has been estimated at 0.4%. **Infection** under the corneal flap is possible. It is also possible that a patient has the genetic condition **keratoconus** that causes the cornea to thin after surgery. Although this condition is screened in the preoperative exam, it is possible in rare cases (about 1 in 5,000) for the condition to remain dormant until later in life (the mid-40s). If this occurs, the patient may need rigid gas permeable contact lenses, Intrastromal Corneal Ring Segments (Intacs), Corneal Collagen Crosslinking with Riboflavin or a corneal transplant.
- Persistent dry eye has been estimated to be as high as 28% in Asian eyes and 5% in Caucasian eyes. Nerve fibers in the cornea are important for stimulating tear production. A year after LASIK, subbasal nerve fiber bundles remain reduced by more than half. Some patients experience reactive tearing, in part to compensate for chronic decreased basal wetting tear production.
- Subconjunctival hemorrhage has been estimated at 10.5%

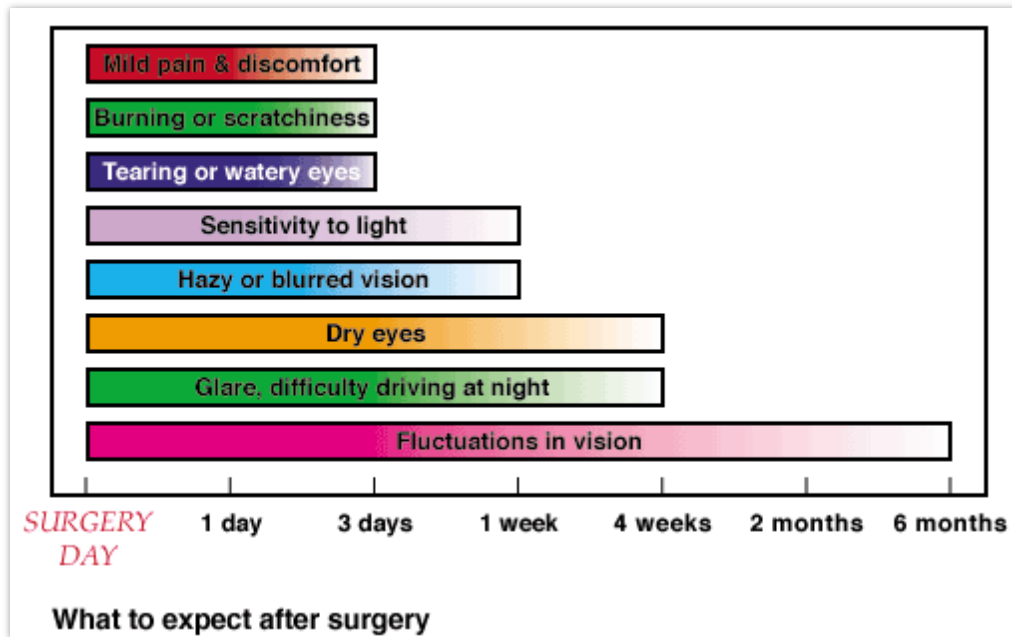
Late postoperative complications:

- Epithelial ingrowth has been estimated at 0.1%.
- Glare.
- Late traumatic flap dislocations have been reported 1–7 years post-LASIK
- Halos or starbursts around bright lights at night are caused by the irregularity between the lasered part and the untouched part. It is not practical to perform the surgery so that it covers the width of the pupil at full dilation at night, and the pupil may expand so that light passes through the edge of the flap into the pupil. In daytime, the pupil is smaller than the edge. Modern equipment is better suited to treat those with large pupils, and responsible physicians will check for them during examination.

Other:

Lasik and other forms of laser refractive surgery change the dynamics of the cornea. These changes make it difficult for your optometrist and ophthalmologist to accurately measure your intraocular pressure, essential in **glaucoma** screening and treatment. The changes also affect the calculations used to select the correct intraocular lens implant when you have cataract surgery. This is known to ophthalmologists as "refractive surprise." The correct intraocular pressure and intraocular lens power can be calculated if you can provide your eye care professional with your preoperative, operative and postoperative eye measurements.

The incidence of **macular hole** has been estimated at 0.2 percent to 0.3 percent.
 The incidence of **retinal detachment** has been estimated at 0.36 percent.
 The incidence of **choroidal neovascularization** has been estimated at 0.33 percent.
 The incidence of **uveitis** has been estimated at 0.18 percent



✓ Laser Epithelial Keratomileusis (LASEK)

A **LASEK** procedure involves preserving the extremely thin epithelial layer by lifting it from the eye's surface before laser energy is applied for reshaping. After the LASEK procedure, the epithelium is replaced on the eye's surface.

Deference between LASIK and LASEK

In LASIK, the thicker flap is created with the [Microkeratome](#) cutting tool or a special laser. With LASEK, the ultra thin flap is created with a special cutting tool known as a [Trephine](#).

The LASEK Procedure

During LASEK, surgeon uses local anesthesia. Then a cut is made in the epithelium, or outer layer of the cornea, with a fine blade (trephine). Then the surgeon covers the eye with a diluted alcohol solution for approximately 30 seconds, which loosens the edges of the epithelium.

After sponging the alcohol solution from the eye, the surgeon uses a tiny hoe to lift the edge of the epithelial flap and gently fold it back out of the way. Then, by using [Excimer laser](#) to sculpt the corneal tissue underneath. Afterward, the epithelial flap is placed back on the eye with a type of spatula.

After LASEK

In many ways, LASEK vision recovery is slower than LASIK recovery, but there are some differences. According to doctors who perform LASEK, the flap edge heals in about a day, though patients usually wear a bandage contact lens for approximately four days to protect the eye.

The patient may feel irritated during the first day or two afterward. Also, with LASEK compared with LASIK, it often takes longer to recover good vision — up to 4 - 7 days — but this can vary from one person to the next.

In some studies LASEK has been associated with faster recovery of sensation or nerve function in the eye's surface (cornea) compared with LASIK. It also may cause dry eye less frequently than LASIK.

Intraocular implantation surgeries:

✓ Clear Lens Extraction and Intraocular Implantation

An **intraocular lens (IOL)** is an implanted [lens](#) in the [eye](#), and **Clear Lens Extraction** means replacing the existing [crystalline lens](#) a form of [refractive surgery](#) to change the eye's [optical power](#) with or without intraocular lens placement as a refractive procedure.

CLE usually is reserved for high myopic patients (>8 [D]) not easily managed by other refractive procedures (LASIK, PRK). However, it may be an even better choice for patients with high Hyperopia than for Myopias because of the smaller risk of postoperative retinal detachment.

Contraindications:

Contraindications include retinal disease. With high myopia, there is a higher rate of retinal detachment than with other types of refractive errors.

Preoperative prophylactic treatment of the peripheral retina, especially in patients with preexisting abnormalities and in high myopias. So far, published results on CLE have shown that prophylactic 360° laser therapy provides a lower incidence of postoperative detachment than direct treatment limited to the visible abnormalities, which shows little difference from no treatment at all.

Preoperative

Prednisolone acetate 1%

Sterile ophthalmic suspension that is a topical anti-inflammatory agent for treating steroid responsive inflammation of the palpebral and bulbar conjunctiva, corneal and anterior segment.

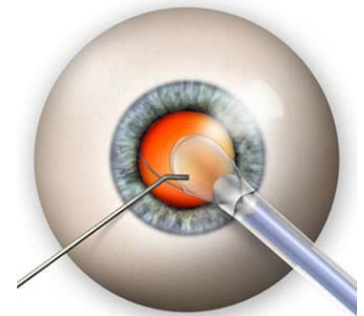
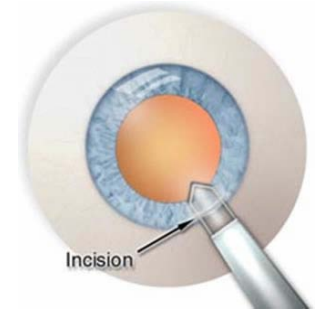
- **Contraindications:** Documented hypersensitivity; contraindicated in most viral diseases of the cornea and conjunctiva, including epithelial herpes simplex Keratitis (dendritic Keratitis), Vaccinia, and Varicella, and also in Mycobacterial infection of the eye and fungal diseases of ocular structures; prolonged use may lead to glaucoma and cataracts
- **Precautions:** Fungal infections of the cornea are prone to develop coincidentally with long-term local corticosteroid use; suspect fungal invasion in any persistent corneal ulceration where a corticosteroid has been used or is in use; obtain fungal cultures when appropriate; if used for 10 d or longer, monitor intraocular pressure

Ciprofloxacin 0.3%

Antibiotic

Procedure

1. Preparation:
Retrobulbar or peribulbar anesthesia
Superior rectus suture with 4/0 silk
2. Conjunctival peritomy
3. Full thickness limbal incision with Beaver blade and complete incision with scissors, from 9-3 o'clock Peripheral iridectomy with Vanna scissors
4. Lens removal
5. Constrict pupil
6. Reform AC with viscoelastics
7. Wound closure 10/0 nylon sutures
8. Subconjunctival steroid and antibiotic injection
9. Dry lens with Weck sponge
10. Apply cryoprobe between iris and cornea onto lens
11. Alternatively, can use vectis and forceps to remove lens
AC-IOL implantation Insert AC-IOL with help of lens glide 70%



Follow-up care:

See the patient on day 1 postoperatively, and then 1-week postoperatively, and subsequently 1-month postoperatively at which point a refraction usually may be performed.

Instructions are given to call if vision suddenly deteriorates instead of slowly improving, if pain occurs, or the eye becomes red or inflamed.

Otherwise, follow-up care is as for cataract surgery with attention to the same possible complications.

Complications

Complications include the following:

- Posterior capsular opacification
- Retinal detachment
- Macular edema

Those are related to correction of the extreme errors.

The remaining complications are the same as for any cataract surgery; include the following:

- Endophthalmitis.
- Corneal edema from endothelial disruption, vitreous touch.
- Wound distortion or disruption, leading to astigmatism and iris prolapse.
- Shallow or flat anterior chamber.
- Glaucoma Uveitis ,Intraocular lens dislocation ,Hemorrhage (anterior segment or vitreous) ,Capsular rupture or zonular dialysis ,Corneal melting with ocular surface disease ,Filtering bleb ,Hypotony

,Iridodialysis ,Malignant glaucoma ,Retained lens material ,Suprachoroidal hemorrhage or effusion (particularly in hyperopes),Wound leak ,Retinal light toxicity ,Wrong power IOL .

| ✓ Phakic Intraocular implants:

Used to treat a wide range of hyperopia and myopia, this procedure involves inserting an intraocular lens (IOL) into the eye's anterior chamber or posterior chamber. This procedure differs from Clear Lens Extraction in that the eye's natural lens is left in place. Like Clear Lens Extraction this procedure is used primarily to treat extremely high myopia.

Types of IOLs:

- Angle-supported,
- Iris-fixated, and
- Pre-crystalline varieties.

| Angle-supported

The angle-supported lens becomes fixated somewhere in the angle structures. There cannot be a perfect size of the IOL. A well-fixed lens is supposed to rest its haptics on the scleral spur. In actuality, the haptics press against the corneoscleral trabeculae and the Schlemm canal and, sometimes, the blood vessels in the vicinity that overlie the scleral spur. The haptics impinge on the nerve endings in the angle of the anterior chamber. However, nothing is known about this interaction. The haptics press on the segmental blood supply of the iris, leading to ischemia and iris atrophy, which results in progressive ovalization of the pupil. The haptics can erode through the angle tissues and become lodged in the ciliary body.

A loose angle-supported lens can move around and damage the corneal endothelium. Tissue reactions and damage to the angle of the anterior chamber can cause breakdown of the blood-aqueous barrier, uveitis-glaucoma-hyphema (UGH) syndrome. Anterior segment inflammatory pathology may find an echo in the development of cystoid macular edema. Microtrauma and macrotrauma of any nature can accelerate the pathological changes in the angle.

| Iris-supported lenses

Iris claw lenses also are made of PMMA; the overall length of the implant varies from 7.2-8.5 mm, the size of the optic varies from 5-6 mm. The optic is convexo-concave, with a maximum height of 0.96 mm. The lens also is vaulted at the haptic to clear the natural vault of the iris.

The haptics become fixed to the midperiphery of the iris through the medium of the claws, located on either side of the lens. The amount of iris engaged into the claw depends on the judgment of the surgeon at the time of surgery.

The size of the IOL precludes all angle-related complications. No pupil- or posterior pigment epithelium-related problems occur because at no time does the lens come into contact with either of them. A concern does exist regarding chronic inflammation as a result of continued compression of the iris tissue in the claws. The inclusion of excessive iris tissue in the claws during surgery can push the lens against the iris and the crystalline lens. This

can interfere with the free circulation of the aqueous through the pupil, possibly resulting in the formation of posterior synechia and inflammation.

Micromovements, such as blinking and squeezing, do not bring together the endothelium of the cornea and the optic of the IOL. However, forcible rubbing for any reason has the potential to damage the endothelium.

Posterior chamber lenses

The phakic posterior chamber lens or the precrystalline lens is made of a soft material, such as silicone or collamer. The overall length varies from 11-13 mm. The central biconcave optical zone varies from 4.5-5.5 mm. The average thickness of the haptic is 60 μm . In an ideal lens implant situation, it is supposed to remain clear of the crystalline lens by 100-200 μm . The posterior chamber lens is sized empirically by adding 0.5 mm from the white-to-white corneal diameter.

The vaulting of the lens is produced by the elastic single piece lens getting lifted from the ciliary body. This puts some constant pressure, however small, on it. The vaulting may let it stay clear of the crystalline lens, but it physically pushes the iris anteriorly, a tissue normally in touch with the crystalline lens in the central part. This unnatural constant contact pressure and friction might lay the foundation for ciliary body reactions and shedding of posterior pigment epithelium. It also may prevent free passage of aqueous across the pupil. A mistakenly larger sized lens will put more pressure on the iris and push it forward by what may be called the spinnaker effect (blowing sail of a sail boat).

The optimal size remains a matter of conjecture. A mistaken small size allows the lens to rub against the natural crystalline lens (causing cataract) and knock against the ciliary body (setting up uveal reaction) and the posterior surface of the iris (releasing the pigment). The free volume of the restricted posterior chamber space is encroached upon by the implanted IOL and an increase in the size of the natural crystalline lens with age. If the peripheral iridectomy becomes blocked, iris bombé and consequent angle-closure glaucoma will occur. Some of the developments occurring behind the iris cannot be visualized clinically. They can only be speculated.

During blinking, squeezing, and rubbing, the results of pressure and friction between the IOL and the surrounding tissues are unknown. Even if the frictional force is very small, it is bound to continue for life. When shed from the iris and ciliary processes, the pigment may lead to glaucoma. Patients with diabetes can have problems. This disease causes changes in the posterior pigment epithelium of the iris, which may cause excessive shedding of pigment. An inflammatory process can bind the lens to the iris, the ciliary body, or even the crystalline lens. An intermittent or a continuous touch with the anterior lens capsule can produce lens opacification. Sometimes, the presence of the artificial lens in the posterior chamber can crowd the angle of the anterior chamber, leading to glaucoma.

In all phakic IOLs, increased crystalline lens size with increasing age and cataract formation leading to a decrease in the depth of the anterior chamber and crowding in the posterior chamber tend to exaggerate the pathologic processes. While the results of phakic IOLs are highly predictable, long-term data are limited.

Other Surgeries

| ✓ Micro-thin Prescription Inserts

Micro-thin Prescription Inserts INTACS™ are two small arcs of medical plastic that a surgeon places into the mid-periphery of the corneal stroma. Once in place, the inserts cause a slight stretching of the cornea and a subtle flattening of the corneal curvature. The change in curvature varies with the thickness of the inserts. To place the inserts, the surgeon must first create a small incision in the periphery of the cornea. The inserts are then placed. Finally, the surgeon closes the incision (a suture may sometimes be required). Once placed, the inserts can be removed or replaced by the surgeon if the patient's vision needs change. Under U.S. clinical study since 1991, KeraVision INTACS™ received FDA approval for the correction of -1.00 to -3.00 D of myopia with no more than 1.00 D of astigmatism in April 1999.

| ✓ Multiple Procedures

Doctors will sometimes use two or more procedures to treat patients suffering from high to severe myopia. For instance, ophthalmologists have inserted phakic IOLs and then performed LASIK to achieve the desired refraction in eyes with more than -15D of myopia pre-operatively. Surgeons have also performed initial LASIK procedures then inserted ICRS to correct residual errors. However, patients should understand that the use of multiple procedures is a relatively new option in many countries, including the United States. Very little study data has been accumulated on the long-term effects of multiple procedures, and patients may need to look harder to find a surgeon currently performing such procedures in combination with one another.

| ✓ Radial keratotomy

Radial keratotomy, or RK, was refined by a Russian ophthalmologist in 1963 and involves using a diamond scalpel blade to make usually four to eight tiny spoke-like incisions in the periphery of cornea. The incisions slightly weaken the peripheral cornea, causing it to bulge. This flattens the center of the cornea, thus reducing myopia.

RK has its drawbacks. The resulting change in refractive error is felt to be less predictable because no one can control the way the incisions heal. As a result, RK may only reduce myopia, not completely eliminate it. RK patients may still need to wear glasses for distance. In addition, with time, RK can result in overcorrection. Because of advances in laser technology, surgeons perform RK only on a select group of patients.

| ✓ IntraLase Surgery

A newly developed technology called IntraLase appears to enhance the safety of LASIK vision correction by using laser energy instead of a Microkeratome, a cutting tool with a metal blade used in traditional LASIK procedures.

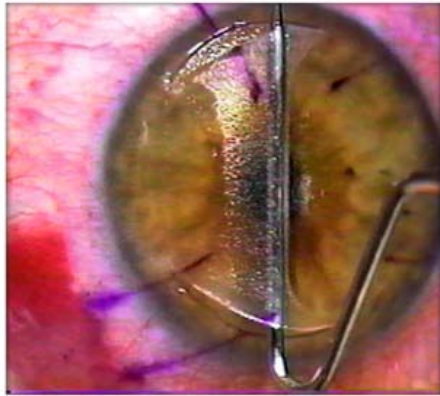
With IntraLase, a special laser is used instead of a blade to create the flap. Then the usual Excimer laser does the ablation. So in the IntraLase procedure, two different lasers are used, which is why LASIK surgeons sometimes call it "bladeless" or "all-laser" LASIK.

As in typical LASIK, the flap then is replaced to serve as a type of natural "bandage" for healing. While LASIK complications are relatively rare, they are sometimes associated with the oscillating blade used with traditional Microkeratomes. Metal blades might create uneven flap edges, resulting in abnormal corneal surfaces and vision defects such as irregular astigmatism.

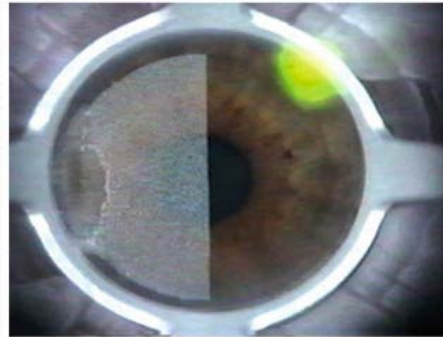
Metal blades also have been associated with formation of incomplete or improperly formed "buttonhole" flaps that can cause vision-threatening scars. Many eye surgeons report these types of complications are far less likely with laser-created flaps.

As a replacement for Microkeratomes, IntraLase creates flaps through infrared laser energy that inserts a precise pattern of tiny, overlapping spaces just below the corneal surface. The IntraLase laser operates at extremely high speeds (pulses of one quadrillionth of a second), allowing tissue to be targeted and divided at a molecular level without heat or impact to surrounding tissue.

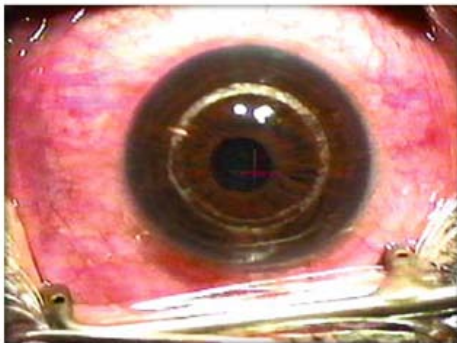
PHOTOES



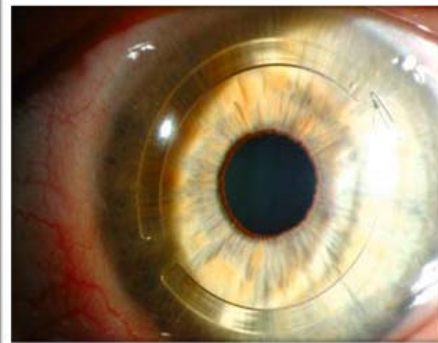
Flap lifting and adhesion lysis using a spatula



Femtosecond laser interface



*Intracorneal ring segments
implanted*



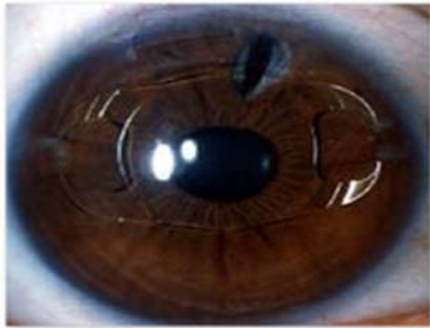
*Intracorneal ring segments
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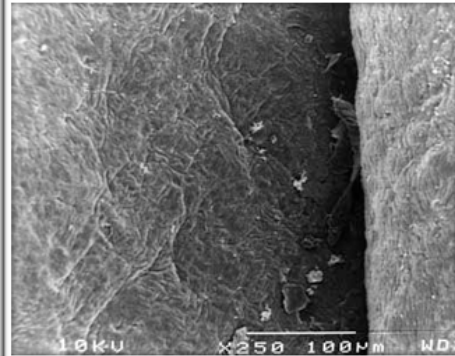
Array Multifocal IOL



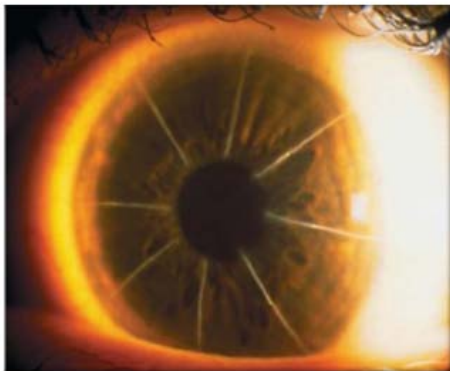
Synchrony Accommodative IOL



Phakic myopia lens



*Stromal interface following flap creation
with the femtosecond laser*



Radial Keratotomy

Resources

- ✓ OPTOMETRIC CLINICAL PRACTICE GUIDELINE : Care of the patient with Myopia/PDF



- ✓ ALLABOUTVISION.com

The LASIK Procedure: A Complete Guide

<http://www.allaboutvision.com/visionsurgery/lasik.htm>



Implantable Lenses (Phakic IOLs)

<http://www.allaboutvision.com/visionsurgery/implantable-lenses.htm>

LASEK Eye Surgery: How It Works

<http://www.allaboutvision.com/visionsurgery/lasek.htm>

PRK: The Original Laser Eye Surgery

<http://www.allaboutvision.com/visionsurgery/prk.htm>

IntraLase: Creating a LASIK Flap with Precision

<http://www.allaboutvision.com/visionsurgery/intralasik.htm>

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Article Last Updated: Apr 18, 2006

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Myopia, Phakic IOL

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Updated: May 16, 2008